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CENTER

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INTERNATIONAL TSUNAMI INFORMATION CENTER

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TSUNAMI NEWSLETTER is published by the International Tsunami Information Center to bring news and information to scientists, engineers, educators, community protection agencies and governments throughout the world.

We welcome contributions from our readers.

The International Tsunami Information Center is maintained by the U.S. National Oceanic and Atmospheric Administration for the Intergovernmental Oceanographic Commission of the United Nations Educational, Scientific and Cultural Organization. The Center's mission is to mitigate the effects of tsunamis throughout the Pacific.

MEMBER STATES

Present membership of the International Coordination Group for the Tsunami Warning System in the Pacific comprises of the following States:

CANADA
CHILE
CHINA
COLOMBIA
COOK ISLANDS
ECUADOR
FIJI
FRANCE
GUATEMALA
INDONESIA
JAPAN
KOREA (REPUBLIC OF)
MEXICO
NEW ZEALAND
PERU
PHILIPPINES
SINGAPORE
THAILAND
UNITED KINGDOM (HONG KONG)
USA
USSR
WESTERN SAMOA

TABLE OF CONTENTS

NATIONAL AND AREA REPORTS

ANNOUNCEMENTS

ABSTRACTS

PACIFIC TSUNAMI WARNING CENTER

FEATURE

The Mexican Earthquakes and Tsunami of 19 and 21 September 1985

George Pararas-Carayannis

A major earthquake measuring 8.1 on the Richter scale struck the Western Coast of Mexico on Thursday, 19 September 1985. The earthquake's epicenter was at 17.18 North, 102.3 West, 150 miles northwest of Acapulco and approximately 250 miles southwest of Mexico City. It's origin time was 13:17.58 Zulu time. The earthquake caused severe damage in three Mexican States of Guerrero, Michoacan, and Jalisco, and had devastating effects in Mexico City. At the present time the death toll has climbed to several thousands. Telephone lines and all communications with Mexico were interrupted. Neither Acapulco, Colima or Manzanillo which were located closer to the earthquake epicenter sustained any significant damage. A number of major aftershocks occurred on the following days, the most important occurring on 21 September at 01:37 Zulu at 18.4 North, 101.5 West with a magnitude of 7.3. This second earthquake also produced a small tsunami.

The earthquake and tsunami generating area was near a part of the Mexican Coast where the Cocos crustal plate moves eastward and underthrusts the North American plate along the mid-American trench. The earthquake occurred near the so called Michoacan gap which has been building up a great deal of stress in the last few decades.

A small tsunami propagated across the Pacific and was recorded by several tide stations in Central America, Colombia, Ecuador, French Polynesia, Samoa, and Hawaii. The following is a summary of the tsunami as recorded at different tide stations in the Pacific:

Guatemala	Negligible tsunami effect
Acajutla, El Salvador	58 cm
Puerto Armuelles, Panama	0 cm
La Libertad, Ecuador	60 cm
Baltra Island, Galapagos	21 cm
Rikitea, French Polynesia	7 cm
Papeete, French Polynesia	5 cm
Pago Pago, American Samoa	24 cm
Apia, Western Samoa	14 cm
Hilo, Hawaii	22 cm
Kahului, Hawaii	24 cm
Chilean tide stations	0 cm
La Jolla, California	0 cm

No reports of damage were received from any of the stations, and only minor damage due to the tsunami was reported from the source region.

Tsunami stations in Manzanillo and Socorro were not functioning and did not respond to queries initiated by the Pacific Tsunami Warning Center. On the basis of the magnitude of the 19 September earthquake and of confirmation of waves recorded at La Libertad, a tsunami watch went into affect at 14:05 Zulu time and was subsequently cancelled at 16:20 Zulu when reports from tide stations indicated a small tsunami magnitude. Only an informational bulletin was issued for the 21 September earthquake.

A survey was made by ITIC of the coastal area affected by the tsunamis by the 19 and 21 September 1985 earthquakes in Mexico. The survey covered the west coast of Mexico from Manzanillo to Zihuatanejo only. A tide gauge record of the tsunamis as recorded at Acapulco was provided by Ing. Grivel of the University of Mexico. This is the only analog tide gauge record obtained from the immediate region (see figures 1 and 2). The record shows two distinct tsunamis with approximate double amplitude (trough to crest) of 4.7 feet for both of them and average period of 12-14 minutes. No other records of the tsunamis were obtained from the west coast, although several digitally recording tide stations exist. Because the sampling rate of these gauges is every fifteen minutes, the tsunamis may have been substantially filtered and were not evident in the record.

Specific measurements were made and interviews with local residents in the coastal areas were conducted. The tsunami measured from 1 meter to approximately 3.0 meters from Manzanillo to Acapulco. Tsunami height in the order of 1 meter was reported from Manzanillo. Maximum wave heights of approximately 3.0 m were measured at the town of Zihuatanejo. At Lazaro Cardenas, the town closest to the epicenter, maximum tsunami height was approximately estimated at 2.8 meters with inland inundation of up to 180 feet.

A more detailed report of the results of the ITIC survey and a study of the tsunami source mechanism are under preparation. The relatively small tsunamis generated by these large earthquakes are attributed to the shallow angle of subduction (10^{o}) of the Cocos plate underneath the North American plate for this particular region and to the small vertical component of crustal displacements.

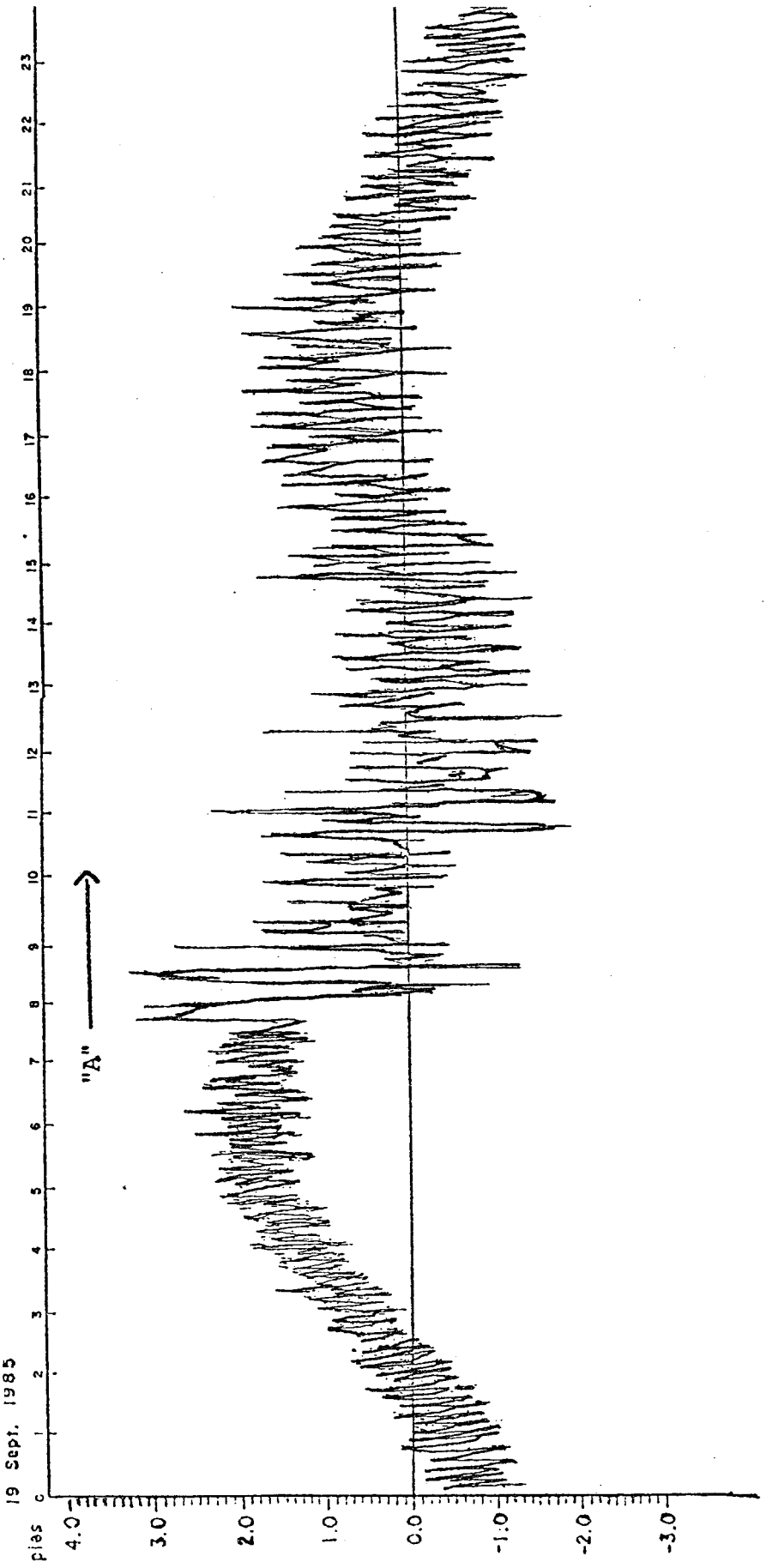


Figure 1. Tide Gauge Record of 19 September 1985

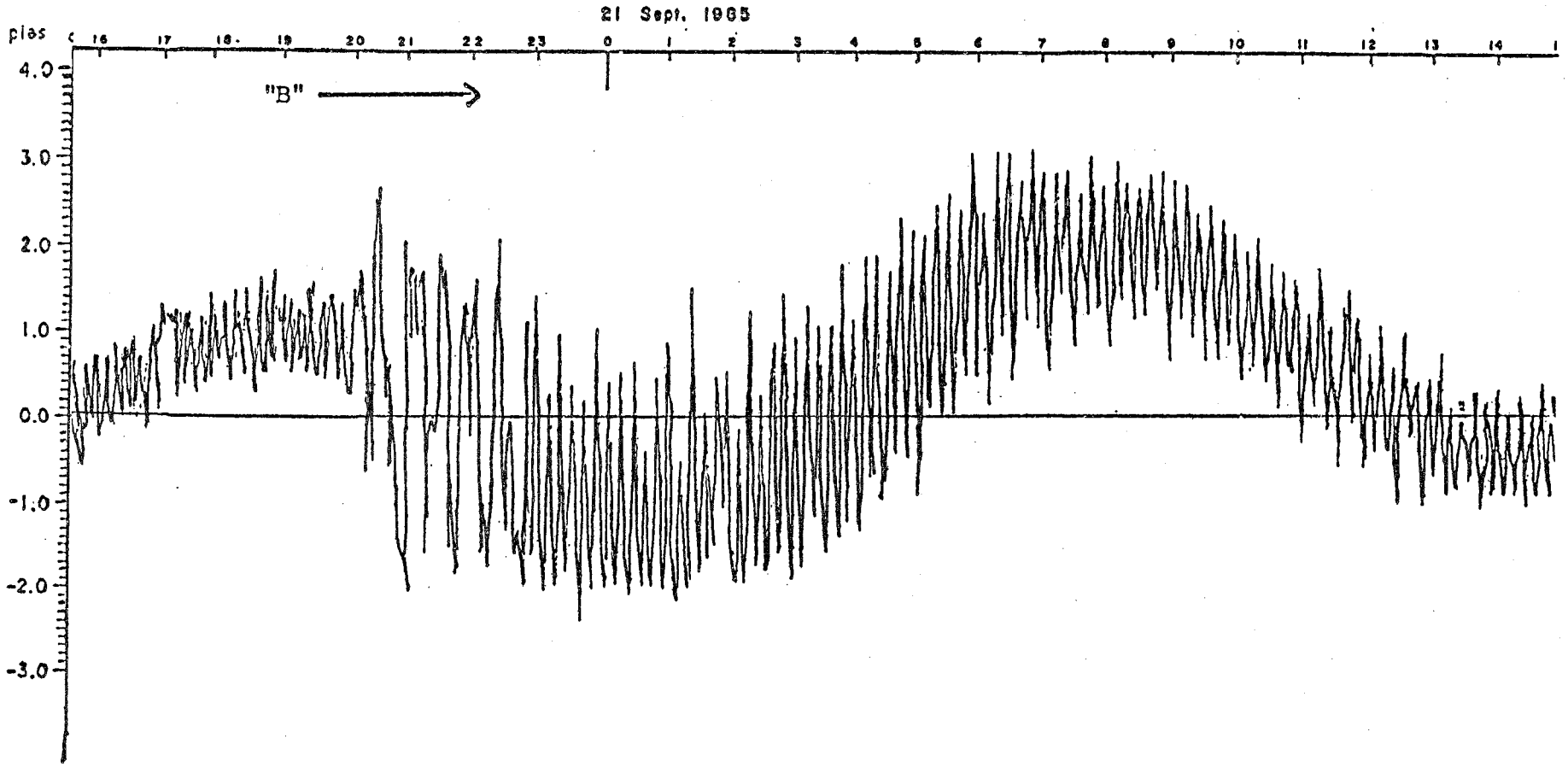


Figure 2. Tide Gauge Record of 21 September 1985

NEWS EVENT

Nevado del Ruiz Eruption

On Wednesday of 13 November 1985, shortly after 9 p.m. local time, the 17,716 ft-high, long-dormant volcano known as Nevado del Ruiz, in the Central Cordillera of Colombia erupted with violence after a 500 year rest. The volcano began sending up plumes of smoke more than a year ago, and on two occasions, in September, the volcano sent out showers of rock and ash, giving signs of its rebirth and potential destructiveness. Authorities in the area began drawing contingency plans of preparedness, but the eruption occurred too soon for these plans to be implemented.

The eruption of 13 November sent millions of tons of ash into the atmosphere obscuring the sun. There were no lava flows, but tremendous quantity of debris and rocks fell in the surrounding area. About 90 minutes after the first eruption, a second blast followed, creating an atmospheric shock wave that was so powerful that it was felt in Cali, 150 miles to the southwest.

Although no lava was produced, the heat from the volcano and its eruption melted the thick blanket of snow and ice which covered the upper 2,000 feet of the volcano's peak. The melted ice and snow quickly turned into streams of viscous mud and rocks which cascaded down the flanks of the volcano. Mud flows of 15-30 ft in thickness traveled at speeds up to 30 mph, buring the town of Armero, a distance of 30 miles away. Also destroyed was the town of Ambalema. Death toll at this writing was estimated in excess of 25,000.

Earthquake strikes Algeria

Six persons were killed in the Constantine-Skikda area in Algeria's 27 October earthquake, which measured 5.9 on the Richter Scale.

13 October Earthquake Cripples Tadjikistan, USSR

The earthquake, that registered 5.9 on the Richter Scale, was felt in Tashkent, the Ferghana Valley, Dushanbe, Kulya, and Nurek. Industries and homes were badly damaged; about 3,000 people were left homeless. There were serious loss of human life and damages in the hundreds of millions of dollars. Electric power and telephone lines were broken. The most heavily damaged areas were the outskirts of Kairakkum, the Khodazhent district and Leninabad.

Earthquake in Guatemala

The 11 October earthquake, measuring 4.6 on the Richter Scale, damaged 80% of the buildings in San Miguel, Ustantan. 500 houses were totally destroyed and another 800 severely damaged, leaving 12,000 homeless. Two persons were injured

Japanese Earthquakes

On 4 October 1985 two earthquakes rocked central Japan. There were no reports of damages, but 13 people were injured. The second and greater quake, which registered 6.2 on the Richter Scale, was centered 32 miles northeast of Tokyo in coastal Ibaraki prefecture, according to the Central Meteorological Agency.

Quake Devastated Two Chinese Towns

A major earthquake that measured 7.4 on the Richter Scale devastated Shufu, and Wuqia in western China, killing at least 67 people and leaving 6,000 others homeless on 24 August 1985.

Hindu Kush Suffered Earthquake on 29 July 1985

The 29 July earthquake in the Hindu Kush region was strongly felt in northern India, Pakistan, and the Soviet Union, causing avalanches and disrupting telecommunications and power lines. The 6.6 quake resulted in 5 dead and 38 injured in the Chitral and Swat districts of Pakistan. Damage was also reported from the Dushanbe and Dhroh areas of Uzbekistan, USSR.

22 July Earthquake Shook New Britain

The epicenter of the quake, which measured 6.9 on the Richter Scale, was located in the Solomon Sea, southwest of New Britain Island, about 320 km north of Port Moresby, Papua New Guinea. There were no reports of damages.

Earthquake Rocked New Ireland and New Britain

Report from Peter Lowenstein:

An earthquake on 3 July 1985 caused numerous small to moderate landslides in the epicentral region. The damage in the coastal villages was relatively light, limited to damaged water tanks and collapse of bush-material houses. In Rabaul, 70 km to the west, the felt intensity was MM VI-VII. A 4-foot tsunami was observed in Simpson Harbour and the following seiche could be seen on the tide gauge record for 15 hours. In New Britain the earthquake caused damage, landslides, and ground cracking.

INTERNATIONAL TSUNAMI INFORMATION CENTER

ITIC Survey of Mexican Earthquakes and Tsunamis of 19 and 20 September 1985

Dr. George Pararas-Carayannis, Director of ITIC was invited by Mexican authorities to conduct a survey of the 19 and 20 September earthquakes and tsunamis. (The dates given are the local dates.) The mission was supported by the Intergovernmental Oceanographic Commission.

The purpose of the ITIC mission was twofold:

a) To investigate and survey the tsunami generated by the earthquakes of 19 and 20 September 1985.

b) To assist authorities in Mexico with planning necessary to mitigate the effects of tsunamis in the country and with more active participation in the International Tsunami Warning System

A survey was made of the coastal area affected by the tsunamis generated by the 19 and 20 September 1985 earthquakes in Mexico. The preliminary results of the survey are presented in a different section of this newsletter. A number of contacts were made with scientists at the University of Mexico and at the Oceanographic Institute in Manzanillo. Interviews of local residents in the coastal area were carried out and measurements were made.

Based on the survey and review of historical records, it was concluded that local earthquakes can produce potentially dangerous tsunamis on the West coast of Mexico.

Based on this mission and findings a number of recommendations were made on the need for establishment of water level monitoring stations in support of national and international scientific, oceanographic, meteorological and geophysical programs. Also the need for tsunami preparedness was emphasized.

ITSU-X Meeting in Sidney, British Columbia, Canada

The tenth session of the International Coordination Group for the Tsunami Warning System in the Pacific (ITSU-X) opened in Sidney, B.C., Canada on Thursday, 1 August 1985. The Provisional Agenda was as follows:

I. Administrative Arrangements for the Session

A. Adoption of the Agenda

B. Election of the Rapporteur

C. Conduct of the Session, Timetable and Documentation

II. Intersessional Activities

A. Reports by the Chairman of the Group and the Director of ITIC on Intersessional Activities (IOC/ITSU-X/6, IOC/ITSU-X/7)

B. Discussion of National Inputs to the Improvement of the ITSU Network in the Pacific (IOC/ITSU-X/8)

C. Implications of the Decisions Taken by the Thirteenth Session of the IOC Assembly (12-28 March 1985, Paris) on the Group's Activities

III. Implication of the Resolutions and Recommendations of the Ninth Session of the ICG/ITSU (13-17 March, 1984, Honolulu)

A. Discussion and Adoption of the Master Plan for International Tsunami Warning Operations (IOC/ITSU-X/9)

B. Status of Preparation of Additional Tsunami Travel Time Charts

C. Results of the Survey of the Necessity of an International Communication Plan

IV. Modus Operandi, Mandate and Function of the International Tsunami Information Center

V. Regional Development of the Tsunami Warning System and Training Activities under the ICG/ITS - Status and Plans

A. After-Effects of the Mission to the Western Pacific (January 1984) for the Improvement of Regional Cooperation

B. Results of the Workshop on the Technical Aspects of Tsunami Analyses, Prediction and Communication

C. Implementation of the Inviting Experts Programme - Conclusions and Proposals for Future Actions

VI. Review of Plans and Activities of the ICG/ITSU for 1986-1987(DOC.IOC/ITSU-X/11)

VII. Other Business

VIII. Date and Place of Next Session

IX. Selection of a Vice Chairman

X. Adoption of the Summary Report, Resolutions and Recommendations

XI. Closure of the Session

The proceedings of the X Session of ITSU have been published in a summary report of the Intergovernmental Oceanographic Commission.

Tsunami Workshop

A workshop on the Technical Aspects of Tsunami Analyses, Predictions and Communication was held at the Institute of Ocean Science in Sidney, British Columbia from 29 July to 1 August 1985. The workshop, which preceded the ITSU-X meeting, was sponsored by the Intergovernmental Oceanographic Commission, and was hosted by the Canadian Government.

The objective of the 3-day workshop was a direct exchange of views on the different aspects of the Tsunami Warning System, communications, and forecasting and related subjects and specific problems. It dealt with the operation of the Tsunami Warning System in the Pacific, providing participants with round table discussions for each major topic, and an opportunity for a direct exchange with experts on different fields. Dr. George Pararas-Carayannis was designated as Chairman and Mr. Steve Rinard as Rapporteur.

The following is an outline of the program:

I. Introduction

A. IOC--Role in the Tsunami Warning System (I. Oliounine, G. Pararas-Carayannis)

B. ITSU--Role and Significance of the International Coordination Group for the Tsunami Warning System in the Pacific (N. Ridgway)

II. Tsunami Data Collection

A. Historical Data Collection (G. Pararas-Carayannis)

B. Historical Study of Tsunamis (S. Wigen)

C. Tsunami Data Bases (J. Lander)

III. Activities and Responsibilities of Existing Tsunami Warning Centers

A. Pacific Tsunami Warning Center (G. Burton)

B. Hawaii Regional Tsunami Warning Center (G. Burton)

C. Alaska Regional Tsunami Warning Center (T. Sokolowski)

D. Japan Tsunami Warning Center (M. Katsumata)

E. USSR Tsunami Warning Center (S. Soloviev)

IV. Need For Structure of Future Regional Tsunami Warning Centers (G. Dohler)

A. "THRUST" Programme (E. Lorca)

V. Operational Procedures

A. Tsunami Watch and Warning Procedures (G. Burton)

B. Water Wave Reporting Procedures (G. Pararas-Carayannis)

C. Communication Plans (R. Hagemeyer)

VI. Tsunami Preparedness

A. Tsunami Hazard Analysis. Tsunami Hazard Planning Protective Measures. Tsunami Exercises and Public Education (G. Pararas-Carayannis)

VII. Tsunami Research

A. Overview of the State of Tsunami Research (T. Murty)

B. Modelling and Numerical Techniques (S. Soloviev, J. Hebenstreit)

VIII. Tsunami Instrumentation

A. Seismological Instrumentation (M. Katsumata)

B. Water Level Measuring Instrumentation (G. Dohler)

C. Deep Ocean Tsunami Gauges (E. Bernard)

D. Telemetry Systems (Satellite and Ground Telemetry for Data Collection and Communication-Signal Processing) (G. Pararas-Carayannis, R. Hagemeyer, G. Burton)

The workshop was concluded with the following recommendations:

1. Recognizing the value of historical data collection in understanding the tsunami phenomenon, and the importance of the historical data base for operational analysis, the workshop recommends that historical documentation of tsunamis should be compared and that a data base format be established to serve as a comprehensive standard in the collection of seismic and hydrologic parameters of historical tsunamis.

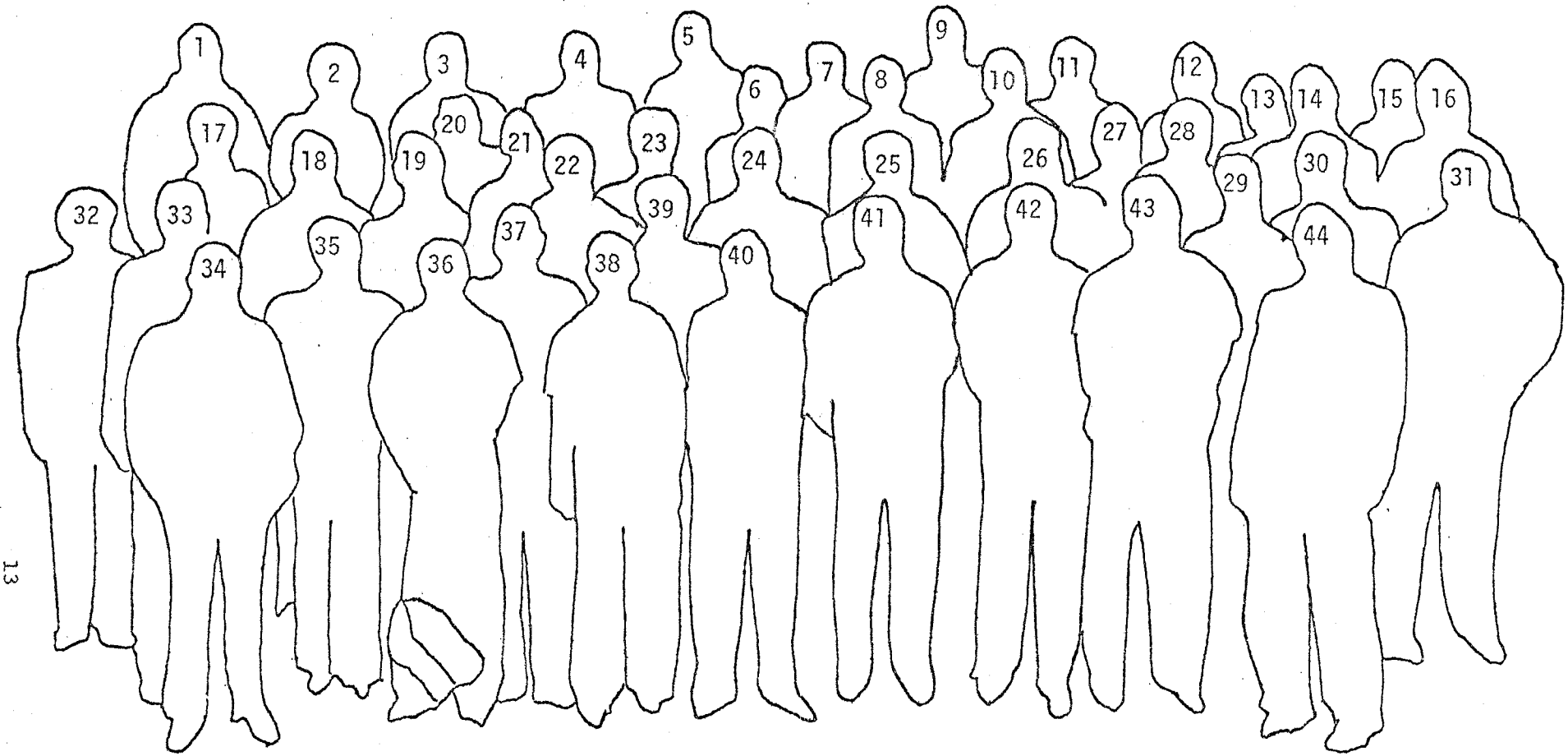
2. In reviewing tsunami preparedness in the Pacific and in recognizing the importance of education in hazard perception by the public, rendering greater effectiveness to the TWS, the Workshop stressed the need for extensive public education and recommends support of an educational program on tsunamis aimed at the general public.

3. Recognizing that a diversity of terms is used in describing the tsunami phenomenon which involves a wide variety of scientific and non-scientific groups in a variety of interdisciplinary fields, the Workshop recommends the preparation of a glossary of tsunami related terms to serve as the basis for defining and understanding tsunami terminology.

4. Recognizing the need of establishing Regional Tsunami Warning Centers in the South Pacific and elsewhere, keeping in mind that these facilities and associated tidal instrumentation, telemetry systems and communications could also serve to monitor other natural hazards such as storm surges, and that measurements made could also be of considerable importance for scientific research including the World Climate Research Program, the Workshop recommends that efforts be made for the establishment of such Regional Tsunami Warning Centers particularly in the Southwest Pacific Region.

5. Workshop participants recommend to scientists to undertake the necessary research to correlate intensity of felt earthquakes on the shore with the probability of tsunami run-up and to provide this information to the TWS for the purpose of warning the population in these earthquake coastal regions where the effects are felt.

6. Workshop participants recommend the investigation in the correlation of time-amplitude range of p-wave oscillations at different epicentral distances and of different frequency pass bauds to the tsunamicity of earthquakes and use this parameter, in addition to the earthquake magnitude, as a measure of tsunami probability.



Participants of the Tsunami Workshop held on 29-31 July 1985
at the Institute of Ocean Sciences, Sidney, British Columbia

1. James F. Lander
2. Pat McLaren
3. John Smedley
4. G. G. Elder
5. Reece B. Black
6. Dick Hagemeyer
7. Richard Behn
8. Larry Pearce
9. Gerald T. Hebenstreit
10. Kennedy Smyth
11. H. J. Meyer
12. Gordon D. Burton
13. I. Oliounine
14. Russ Congdon
15. Masami Okada
16. Joe Stanhope
17. Galo Padilla
18. S. L. Tongilava
19. John Flavell
20. Thomas Sokolowski
21. Jeffrey Zelt
22. Eddy Sanchez B.
23. Mamoru Katsumata
24. Willie Rapatz
25. Steve Rinard
26. S. L. Soloviev
27. Iouri Beliaev
28. Slava Gusiakov
29. Ernesto Cajiao
30. Fred Stephenson
31. Gabril Paris
32. Kim Sang-Jo
33. Tad Murty
34. Mike Considine
35. George Pararas-Carayannis
36. Julio Kuroiwa
37. K. Iida
38. Kuniaki Abe
39. Gerry Dohler
40. Humberto Garcia
41. Felix Espinoza
42. Emilio Lorca
43. Norman Ridgway
44. Sid Wigen

Scientists from Korea and Colombia Visits ITIC

Mr. Ki-Young Kim of Seoul, Korea and Mr. Clemente Ropain of Bogota, Colombia recently participated in the Visiting Expert Program, sponsored by UNESCO-IOC from 3 October - 14 November 1985.

Mr. Ki-Young Kim
Seoul, Korea

Mr. Clemente Ropain
Bogota, Colombia

Mr. Kim is a Weather Forecaster at the Meteorological Office at Kimpo Airport, Seoul, Korea. During the six-week visit, Mr. Kim had a comprehensive coverage of tsunami generation, propagation, and terminal effects, as well as familiarity with the Pacific Tsunami Warning System, wave reporting procedures, and tidal, seismic, and communications instrumentation used by the Tsunami Warning System. Mr. Kim, after his return to Korea, will develop a public tsunami education program to educate the public of the dangers of tsunamis.

Mr. Ropain is a Geophysicist at the Instituto Nacional De Investigaciones Geologico Mineras - Ingeominas. During his training, Mr. Ropain became acquainted with the operational procedures of the Pacific Tsunami Warning Center, including wave reporting procedures, and tidal, seismic, and communications instrumentation used by the Tsunami Warning System. Communications with Colombia for receipt of tsunami messages via AFTN Circuit were established during his training at PTWC. Mr. Ropain will use his training to assist in the establishment of a local Tsunami Warning Center for Colombia, which eventually may be extended into a Regional Tsunami Warning Center, which may include Peru, Ecuador, Panama, Guatemala and Mexico.

ITIC VISITORS

Mark W. Clardy	Assistant Geologist, Dames & Moore, Honolulu, Hawaii
Carolyn Troine	Honolulu, Hawaii
Walter R. Goto	National Weather Service
Paul Bueger	National Meteorological Forecast Service
Eyal Gershfeld	Honolulu, Hawaii
Lynne Mendel	Realtor, Honolulu, Hawaii
Zoltan Rudolics	Realtor, Honolulu, Hawaii
Don Millman	Writer, Honolulu, Hawaii
Dr. Petar Jovanovic	National Academy of Science, Yugoslavia
Dr. Ronald L. Lavoie	Chief, W/OM2, Silver Spring, MD
Zhou Qinghai	Assistant Engineer, National Marine Forecasting Center, Beijing, China
Yang Huating	Deputy-Director, National Marine Forecasting Center, Beijing, China
Al Eftekhany	Graduate Student, Austin, Texas
William Adams	Tsunami Research Specialist, JIMAR, UH
S.A. Dobrenchult	U.S. Dept. of State (Retired)
Guy Field	Honolulu, Hawaii
Sharon Schamber	Honolulu, Hawaii
Debra J. Vischer	Honolulu, Hawaii
Mr. & Mrs. Peter Toornas	Fairfield, Connecticut
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Debra Greno	Honolulu, Hawaii
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Margie Vemity	Marketing Representative, Wang Laboratories
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V. Livstrand	Stockhom, Sweden
Ruth Link	Journalist, Stockholm, Sweden
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Wolfgang Scherer	Technical Manager, National Ocean Service
Nathan Watanabe	Sales Representative, Adler-Royal Business Machines, Inc.
Randy Honebrink	Teacher, Our Redeemer Lutheran High School
Faye Yamamoto	Small Business Administration, Honolulu
Grace Wong	Service Corps of Retired Executives, Honolulu
Jennifer Thayer	Student, Punahou

UNESCO — IOC — ITSU

Intergovernmental Oceanographic Commission's 25th Anniversary

IOC celebrated its 25th anniversary during the thirteenth session of the Assembly held at Unesco headquarters in Paris from 12 to 28 March 1985. IOC composed of 40 Member States when it was first established. Now it has a membership of 112.

The initial aim of IOC was "to promote scientific investigation with a view to learning more about the nature and resources of the oceans through the concerted actions of its members."

IOC was set up within the framework of Unesco, in accordance with the recommendations of the Intergovernmental Conference on Oceanographic Research held in Copenhagen in 1960, and with the assistance of the United Nations, the Food and Agriculture Organization of UN (FAO), the World Meteorological Organization (WMO), and the International Atomic Energy Agency (IAEA), all of which helped to organize the conference. Unesco has made a particular effort to encourage cooperation by all its Member States through the programs of the Division of Marine Sciences, in conjunction with the activities of IOC.

The signing of the United Nations Convention on the Law of the Sea is expected to extend the scope of IOC's responsibilities.

IUGG Tsunami Commission

The International Union of Geodesy and Geophysics (IUGG) met August 1985 at Victoria, B.C., Canada. Two Soviet scientists attended the Symposium. Dr. Viacheslav K. Gusiakov of the Novosibirsk Computing Center and Professor S. L. Soloviev of the Institute of Oceanology in Moscow gave presentations on tsunami research in the USSR. Dr. Gusiakov presented results on a coupled earthquake/hydrodynamic model while Professor Soloviev presented research on source mechanisms of tsunamis, on analysis of run-up data from the 1963 Kuril Island tsunami, on the registration of tsunamis by an open ocean tide gauge (150 meter water depth), and on the use of "p" wave seismic data to identify tsunamigenic earthquakes.

During the meeting the Commission voted to move any member from the commission who misses three consecutive meetings. A ballot to elect new members were given. Dr. L. Huang suggested that the Commission seek nominees from Mexico and China.

The Commission members also discussed the value of including the National Research Reports in Symposia Proceedings. Professor Soloviev reported that Academician Alexseev unofficially offered to host the 1989 Tsunami Symposium in Akademgorodok, USSR. The official offer is expected to be forthcoming in 1986.

List of National Contacts of ICG/ITSU

The following is a list of National Contacts of ITSU members on file in the ITIC office. Please inform ITIC if there are any changes.

CANADA	Mr. W. J. Rapatz Regional Tidal Superintendent Institute of Ocean Sciences Dept. of Fisheries and Oceans P. O. Box 6000 Sidney, B. C. V8L 4B2, Canada
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P. O. Box 12-346
Wellington North, New Zealand

NATIONAL AND AREA REPORTS

Geographic Institute "Agustin Codazzi"

On 13 August of this year, the Geographical Institute "Augustin Codazzi" celebrated the 50th Anniversary of its establishment. In Colombia, this organization is the primary entity for cartographic materials, geographic investigations, agricultural studies and classifications, and has in its responsibility the formation and conservation of the national castastro.

Australia's ITSU Membership

Professor R.D. Braddock of Griffith University in Australia has informed ITIC of Australia's membership in the Intergovernmental Coordination Group for the Tsunami Warning System in the Pacific (ICG/ITSU).

According to the Ministry of Science it has been decided that Australia should apply for membership of the Group and the matter is at this writing being coordinated.

NATIONAL REPORT OF FRANCE (FRENCH POLYNESIA)

NOTE: Since the National Report of France was not presented at the time of the ITSU X Conference, it is printed here with minor editorial corrections.

This report will state essentially on the Tsunami Warning dispositions in French Polynesia, as the risk of distant tsunami is much higher than in New Caledonia.

The Laboratoire de Geophysique of the Commissariat a l'Energie Atomique is in charge of the tsunami warning system in French Polynesia. It makes use not only of the informations obtained from the Reseau Sismique Polynesia (Polynesian Seismological Network), but also of those yielded by the Pacific Tsunami Warning Center in Honolulu. All the information is centralized at the headquarters of the Laboratoire de Geophysique and of the Reseau Sismique Polynesien, which is also the CENTRE POLYNESIEN DE PREVENTION DES TSUNAMIS (CPPT) - (Polynesian Tsunami Warning Center). CPPT is situated on a hill slope near the city of Papeete in Tahiti.

I. Instrumentation - Reseau Sismique Polynesien (RSP) (Polynesian-Seismological Network)

The RSP comprises of eighteen short period seismic stations, distributed in telemetered sub-networks and two individual stations at Tubuai (TBI - Australes Islands) and Rikitea (RKT - Gambier Islands). Moreover, the two Tahiti/Moorea (5 stations) and Rangiroa (4 stations) sub-networks which are 350 km distant for are telemetered to CPPT at Tahiti. The total network covers a large area of nearly triangular shape, with maximum distances of 1,000 km from RGI to TBI and 1,800 km from TAH to RKT.

The Tahiti and Rangiroa sub-networks central stations, as well as TBI and RKT stations, are provided with three component recording long period, seismographs. Also, two tide gauges have been installed, the first one in RKT and the other one in Papeete, which is telemetered to CPPT. For a quick information interchange, a phonic SSB transmission network relays the seismological sub-networks, TBI and RKT to CPPT in Tahiti.

The permanent graphic recordings of the short and long periods cover a wide dynamic using several sensibilities and bandwidths:

A. Three sensitivities for short periods with a magnification of:

1. 2×10^6 at 3 Hz
2. 125.000 at 1 Hz
3. 5.000 at 1 Hz

B. Five sensitivities for long periods (flat response in displacement) with a magnification of:

1. 56.000 (from 12 to 50 sec)
2. 2.000 (from 8 to 60 sec)
3. 250 (from 1 to 60 sec)
4. 56 (from 1 to 300 sec)
5. 14 (from 1 to 300 sec)

C. In each sub-network, all seismological, tidal and other information are permanently digitally recorded on magnetic tape. The magnetic recordings at the TBI and RKT stations are triggered by the seismological events. These records present a large dynamic and wide bandwidth.

II. Real-time Earthquake Detection System

A. Each station has a Seismological Event's Detector (DES = Detecteur d'Evenements Sismiques). The DES is sensitive to short periods p waves and alerts the standing watch in case of an earthquake. Three criterias are used for this alert:

1. Amplitude (200 m μ peak to peak of ground displacement at 1 Hz as a threshold)

2. Duration (this amplitude should be recorded at least for 15 seconds)

3. Frequency (0.5 to 1 Hz)

B. Within each sub-network, these criteria have to be satisfied for a least two of the stations. These three criteria are satisfied for an earthquake of magnitude mB about 6.0 and at 30 degrees distant from Tahiti (Tonga-Kermadec subduction zone), or mB 6.5 at 80 degrees distant (Japan, Kuriles, Kamchatka, Aleutian, Alaska, South America). This relatively low threshold makes a wide security allowance for the Tsunami Warning.

III. Tsunami Warning Elaboration

In the case of a strong earthquake, the tsunami warning procedure will be automatically activated at CPPT and in all the RSP centers.

A. First Level of the Warning (pre-warning stage)

CPPT executes the following operations:

1. Transmission to PTWC in Honolulu, of the p and s waves arrival times to CPPT station.

2. Determination of the earthquake characteristics:

a. Localization: based on the p waves (for the short periods) and s waves (for the long periods) arrival times.

b. Focal depth

c. Magnitudes:

- MB - from p waves,
- MS - from Rayleigh waves (period $\sim$ 20 sec) and for all superficial earthquakes with MS > 7.0
- M(100) - from the first or the multiple paths of the 100 second period Rayleigh waves.

3. A computer (HP 9020) processes all these operations (the procedure is given in the annex), but the data are still manually entered. So far, the information telemetered to CPPT in Tahiti (9 short stations and 2 long period stations) are only used. However, CPPT may obtain data from other sub-network and individual stations, after interrogation.

4. As soon as these operations are completed, CPPT will decide on the maintaining of the alert in the function of:

   a. The earthquake localization: tsunami generating area
   b. In focal depth: superficial earthquake
   c. In magnitude MS: greater than 7.0

If all three conditions are met, the decision is taken to proceed to the:

B. Second Level of the Warning

1. The reference earthquakes for the area under consideration are automatically selected from CPPT's data bank of short and long period seismograms and tide gauge records

2. T Waves: CPPT uses a Tsunami Warning System based on the T waves charateristics. As a matter of fact, it has been demonstrated that the knowledge of the duration of the T waves train, depending on the length of the fault rupture, allows the estimation of the earthquake's seismic moment, directly implicated in the energy of the tsunami (see publications 3, 4, 5, 6, 7).

   The T wave propagation may be disturbed, or even prevented from under-sea obstacles (islands, seamounts, archipelagos). Thus, only the T waves detected by the stations which do not present a major obstacle in the direction of the epicenter (Chile: RKT, TBI: Aleutian, Alaska: Rangiroa; Tonga-Kermadec: Tahiti etc..) are taken into consideration by CPPT. Two criterias are being used:

   a. The time during which a threshold of 80 m μ at 3 Hz frequency is reached or exceeded.

   b. The duration of the maximum amplitude, which depends in principle neither on the propagation effects nor on the station.

Limiting values of the duration of the T waves have been determined for each tsunami generating area, in an experimental way for the first criteria and more theorically for the second one. When these limiting values are reached or exceeded, a first warning is issued to the governmental authorities and CPPT decides to pass on the:

C. Third Level of the Warning

Two cases may appear:

1. CPPT has information on the tsunami amplitude given by the tide gauge stations near the epicenter (generally transmitted by PTWC); the alarm is given or not to the governmental authorities, depending on the observed amplitude and the generating area.

2. CPPT has no information concerning the tsunami amplitude:

   a. For areas presenting an immediate risk for Polynesia, the alarm is given half an hour (Tonga-Kermadec) to three hours (South America) after the T wave arrival.

   b. For the other areas, for which the tsunami would reach the Hawaiian Islands before Tahiti, and in the improbable case that no information concerning its amplitude is obtained, the alarm will be issued four hours before the predicted tsunami arrival.

Note: The information transmitted by PTWC in Honolulu are thus of great importance for the Tsunami Warning System in the French Polynesia, and for this reason CPPT would greatly appreciate receiving all tide gauge data as soon as they are available at PTWC.

IV. Diffusion of the Warning in French Polynesia

The size of the territory and the dispersion of its 160,000 inhabitants over about a hundred of islands or so, present a real problem for diffusion of the tsunami alert by broadcast at night, that is outside the normal local radio broadcasting hours. At the present time, the important towns and the most vulnerable points are equipped with standby receiving stations with automatic release. Still, in spite of the efforts spent within the last few years, many thinly populated islands or isolated and inaccessible regions of the main islands remain without such an equipment.

V. Tsunami Prevention

The Tsunami Warning issued by CPPT triggers the application by and of the governmental ORSEC (Assistance Organization) programme. This plan aims the population to be informed on the potential danger as soon as possible and to be advised on all protective actions to be taken at all levels:

On the high islands, the evacuation of the inhabitants from vulnerable zones (bays, coastal plains, small slope river sides) to nearest hills is the simplest thing to be done.

On the low islands (atolls), because of the low altitude of emerging land and taking into account the absence of noticeable relief and possible shelters, particular measures have to be adopted. Fortunately, considering the tsunamis registered during the last century, these low islands seem to be less vulnerable.

VI. Tsunami from the Chilean Earthquake of March 3, 1985

CPPT correctly localized this major earthquake and calculated its magnitudes. The high value of the seismic moment Mo deduced from the magnitude M(100) and confirmed by the duration of the waves, implied the generation of a tsunami. Because of a lack of information from the South American tide gauge stations concerning the amplitude of this tsunami, the CPPT issued a first alarm at 3 hours UT, about 4.25 hours after the earthquake, 3 hours after the T waves arrival at this station in the Gambier Islands, located in the extreme Southeast of French Polynesia. The alarm has been cancelled at 4 hours UT as soon as the message, which is questioned by the CPPT, had been received from PTWC. The amplitude of the tsunami was 11 cm in RKT and 10 cm in PPT.

In the future, CPPT wishes to receive the tide data as soon as possible as they are received by PTWC.

VII. Tsunami Research in French Polynesia

The research work on the tsunamis carried out during the last few years turned to:

The determination of the magnitude M(100) which is more representative of the seismic moment Mo than the magnitude MS which is saturated in case of strong earthquakes. The magnitude M(100) is deduced from the first or the multiple path Rayleigh waves with periods of 100 seconds (reference 8).

The use of the T waves duration for confirmation of sea-bottom deformation and determination of the earthquake's magnitude M(100) or seismic moment Mo and its application to the tsunami warning, as done by CPPT since twenty years ago (see reference 3 to 7).

The historical search on the tsunamis and their effects in French Polynesia and on the amplitudes reached by strong tsunamis registered during the last one and half a century on the coasts of the Polynesian islands.

Indications obtained at several scattered localities within this huge region support some evidence that a tsunami cataclysm, exceeding what is known now, may have happened in the past (probably in the sixteenth century), devastating some islands (see references 1 and 4).

VIII. List of Publications

A. Bourrouilh - Le Jan F.G. and J. Talandier, Major High Energy events in a reef environment : Tsunamis, Hurricanes and tropical cyclones and their effects on the sedimentology and geomophology of an atoll : Rangiroa, Tuamotu, SE Pacific, Marine Geology, In Press - 1985.

B. Cansi Y. and N. Bethoux, T waves with long inland paths : synthetic seismograms, J. Geophys, Res. 90, 5459-5465, 1985.

C. Okal E.A. and J. Talandier, T wave duration, Magnitudes and Seismic Moment of an earthquakes : Application to Tsunami Warning, J. Phys. Earth - In press - 1985.

D. Talandier J., Contribution a la prevention des tsunamis, C.R. Acad. Sci, Paris, Ser. B, 263, 940-942, 1966.

E. Talandier J., Etude et prevision des tsunamis en Polynesie Francaise, These d'Universite, Paris VI, 128 pp. 1972.

F. Talandier J. and E.A. Okal, Human perception of T Waves : the June 22, 1977 Tonga earthquake felt on Tahiti, Bull. Seismol. Soc. Amer., 69, 1475-1486, 1979.

G. Talandier J., les tsunamis en Polynesie Francaise, Bul. Soc. Etudes Ocean., N 210, T XVII, 1980.

H. Talandier J. and D. Reymond, Application Magnitude M(100) of Rayleigh Waves for Determination Seismic Moment, in preparation.

IX. Future Activities

A. A proposal is made to open three new seismological stations, telemetered to CPPT, in Tetiaroa (an atoll located 50 km to the North of Tahiti) and Mehetia (an unhabited island located 130 km to the East of Tahiti). These stations added to the nine stations existing already and telemetered to CPPT will be of particular use for the observation of the volcano seismic activity in this area. However, they will not provide new fundamental information for the tsunami warning system.

B. Automatization of the determination of the seismic waves characteristics, using a microcomputer in each sub-network:

1. Arrival time, amplitudes, duration and frequency of the P waves

2. Amplitudes of the 20 and 100 second period Rayleigh waves

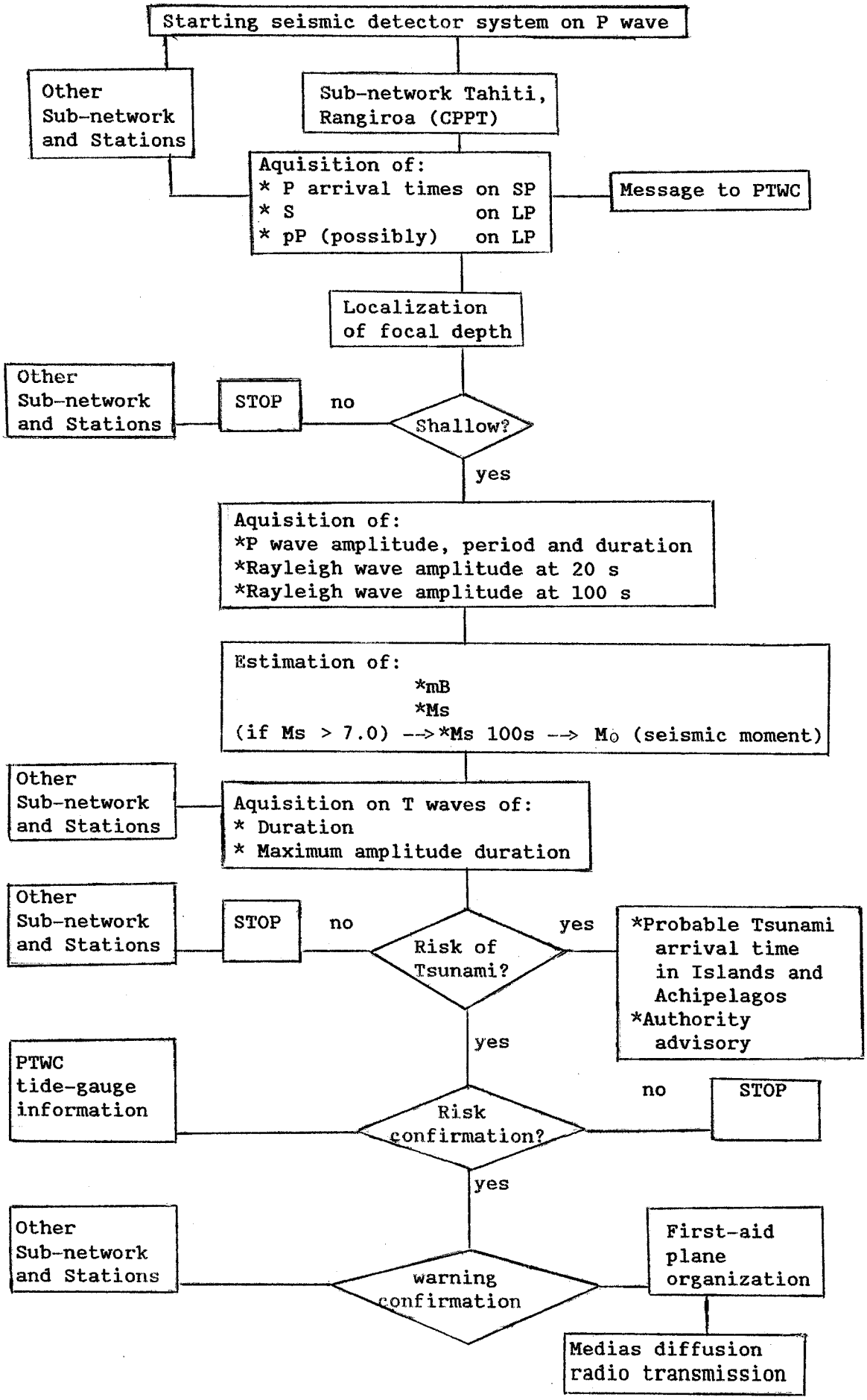
3. Amplitude and duration of the T waves.

C. Completion of the transmission network in order to broadcast the tsunami alert to the islands.

D. Definition of the tsunami risk zones in each island and of the specific measures which have to be adopted in case of danger.

Further information regarding any aspect of this report may be obtained from:

Dr. J. Talandier
Director, Laboratoire de Geophysique
B.P. 640
Papeete - Tahiti
Polynesie Franciase


Starting seismic detector system on P wave
Other Sub-network and Stations
Sub-network Tahiti, Rangiroa (CPPT)
Aquisition of:
* P arrival times on SP
* S on LP
* pP (possibly) on LP
Message to PTWC
Localization of focal depth
Other Sub-network and Stations
STOP
no
Shallow?
yes
Aquisition of:
*P wave amplitude, period and duration
*Rayleigh wave amplitude at 20 s
*Rayleigh wave amplitude at 100 s
Estimation of:
*mB
*Ms
(if Ms > 7.0) --> *Ms 100s --> Mo (seismic moment)
Other Sub-network and Stations
Aquisition on T waves of:
* Duration
* Maximum amplitude duration
Other Sub-network and Stations
STOP
no
Risk of Tsunami?
yes
*Probable Tsunami arrival time in Islands and Achipelagos
*Authority advisory
yes
PTWC tide-gauge information
Risk confirmation?
no
STOP
yes
Other Sub-network and Stations
warning confirmation
First-aid plane organization
Medias diffusion radio transmission

Tsunami Station Inspection

The Pacific Tide Party personnel completed the annual inspection of the following stations:

Unalaska, Alaska	14-15 June 1985
Adak, Alaska	5-6 July 1985
Seward, Alaska	2-4 July 1985
Kodiak, Alaska	20 July 1985
Sand Point, Alaska	23-27 July 1985
Yakutat, Alaska	27-29 July 1985
Crescent City, California	19-20 September 1985
Fort Point, California	27-28 September 1985

ANNOUNCEMENTS

Second International Conference on Interactive Information Processing Systems for Meteorology, Oceanography, and Hydrology will be held January 1986

This second conference will be held in conjunction with the 66th Annual Meeting of the American Meteorological Society along with the National Conference on the Scientific Results of the First GARP Global Experiment (FGGE) and the Sixth Conference on Ocean-Atmosphere Interaction. The Interagency Committee on Water Data will also hold a Workshop on Hydrological Data Exchange in conjunction with the Interactive Conference.

Video tapes used for large screen projection during the conference will be consolidated into a Video Tape Preprint Volume which will also be made available. Therefore, presenters are strongly urged to use videotapes as part of their presentations to bring to the audience the next best thing to a first hand view of their activities and systems.

Nineteenth Session of the Executive Council

The Nineteenth Session of the Executive Council will be held in Paris from 6 - 12 March 1986. The Secretary's report on intersessional activities will cover the following:

1) Climatic changes and the ocean
2) Ocean mapping
3) Marine pollution research and monitoring
4) Application of international system of units in oceanography
5) Ocean services
6) Ocean observing systems
7) International oceanographic data exchange and marine information management

8) International Tsunami Warning System in the Pacific
9) Regional subsidiary bodies and regional co-operation
10) Enhancing the effectiveness of the commission to meet the needs of member states and the world community
11) Medium-term plan, programme and budget

International Symposium on Natural and Man-Made Hazards

The Symposium, sponsored by the Tsunami Society and hosted by the University of Quebec at Rimouski, will be held from 3-9 August 1986 in Rimouski and Quebec City, Canada. The objectives of the Symposium are to promote the advancement of the hazard sciences, to perceive and exploit those aspects that are similar for some of the various hazards, to review the newest developments in a few selected fields, and also to outline new directions for future research.

Interested individuals should contact or write to:

Dr. Mohammed El-Sabh
Department d'Oceanographie
Universite du Quebec a Rimouski
310 Avenue des Ursulines
Rimouski (Quebec)
G5L 3A1
CANADA

The 20th International Conference on Coastal Engineering to be held in Taipei, Taiwan, 9-14 November 1986

Invitations for contributions on the following topics are requested:

Theoretical and Observed Wave Characteristics
Coastal Sediment Problems
Coastal Structures and Related Problems
Coastal, Estuarine and Environmental Problems
Ship Motions

Five copies of a synopsis (not longer than two pages, including illustrations) of each paper proposed for the Conference, together with the names, addresses, affiliations and brief curricula vitae of author and co-authors should reach the following address before 31 October 1985:

Dr. Billy L. Edge
Secretary, Coastal Engineering Research Council
American Society of Civil Engineers
Cubit Engineering Limited
207 East Bay Street, Suite 311
Charleston, SC 29401, USA

PTC '85 Proceedings available

The Proceedings for the PTC '85 is distributed by the University of Hawaii Press, UH Press (2840 Kolowalu St., Honolulu, HI 96822) for the Pacific Telecommunications Council. The cost is $45 (U.S.A.). The theme of the seventh Conference was "Toward a Digital World." The 65 papers in the Proceedings were selected for their significant contribution to the theme.

New Publications Available from National Geophysical Data Center:

Catalog of Strong-Motion Accelerograph Records, Report SE-38

The primary section of this publication is the inventory of strong-motion records, which is arranged alphabetically by country and chronologically by date of earthquake within each country. The inventory includes information on more than 350 earthquakes that occurred in 13 countries from March 1933 through April 1984.

New Digital Strong-Motion Data from Fiji and Solomon Islands

The records cover six earthquakes--three in the Solomon Islands and three in the Fiji Islands, also include uncorrected, corrected, and response spectra data for three components from each station.

New Strong-Motion Data from California Aftershock of July 22, 1983

This is a new set of digital strong-motion data for a magnitude 6.0 earthquake that occurred in the Coalinga, CA, area in July 1983.

Seismicity Map and Catalog for the Middle East Countries, 1900-1983

A new catalog and multi-color map of earthquakes occurring in the Middle East from 1900 through 1983 has been compiled from various files stored at the World Data Center A for Solid Earth Geophysics and from other publications.

Seismicity Map of Middle America

This is a multicolor map which shows the locations of major earthquakes and many smaller events occurring in that region of the world from 1900 through 1979.

World Map of Significant Earthquakes 1900-1979

This is a five-color wall map (approximate scale: 1:32,000,000). The world map shows the location and relative importance of 1,277 significant earthquakes.

The above publications can be ordered from:

National Geophysical Data Center
NOAA, Code E/GCX2
325 Broadway
Boulder, CO 80303

East-West Center--25th Anniversary

East-West Center celebrated its 25th anniversary on 14 May 1985. On 14 May 1960, President Dwight D. Eisenhower signed the law creating the Center, with a mandate to "promote better relations and understanding among the nations of Asia, the Pacific and the United States through cooperative study, training and research."

The Center's first student arrived in September 1960. Since then more than 34,000 people have participated in Center activities, two-thirds from Asia and the Pacific and one-third from the United States. The Center's research is conducted in four institutes and one specialized program. They are:

The Institute of Culture and Communication
The Environment and Policy Institute
The Population Institute
The Resource Systems Institute
The Pacific Islands Development Program, which undertakes research requested by eight heads of government who comprise the Standing Committee of the Pacific Islands Conference.

Report of the Eighteenth Session of the Executive Council, Paris, 11 March 1985 is Available

Report of Governing and Major Subsidiary Bodies of the Eighteenth Session of the Executive Council, which was held in Paris, 11 March 1985, has been issued and available at ITIC. This session acted as the Steering Committee for the Thirteenth Session of the Assembly.

Fifth PSA Inter-Congress

Twenty-seven countries participated in the fifth PSA Inter-Congress which was held in Manila early this year in February. The countries

participated were Australia, Austria, Canada, Chile, Fiji, France, French Polynesia, Federal Republic of Germany, Guam, Hawaii, Hong Kong, Indonesia, Japan, Republic of Korea, Malaysia, Netherlands, New Caledonia, New Zealand, Okinawa, Philippines, Portugal, Switzerland, Taiwan, Thailand, U.S.S.R., U.S.A., and Viet Nam.

ABSTRACTS

Catalog of Tsunamis in Japan and its Neighboring Countries, Special Report

Kumizi Iida
Yachigusa, Japan: Aichi Institute of Technology
December 1984
52 pp.

Covers all tsunamis which occurred in and near Japan or reported in the literature from 684 (Tenmu 13) to 1983 (Showa 58). The tsunami catalog consists of three parts: Part one is the catalog of tsunamis caused by earthquakes, volcanic eruptions and landslides which occurred or reported in and near Japan. Part two is the catalog of tsunamis which occurred in China and Korea. Part three is the catalog of tsunamis which occurred in the Pacific Ocean and struck Japan and its vicinity.

Catalogue of Tide Gauges in the Pacific

Norman M. Ridgway
Paris, France: UNESCO
1984
48 pp.

Catalogue contains information on tide gauges in the Pacific and it describes the types of tide-gauges in operation. Problems associated with the use of different types of tide-gauges are identified and recommendations to overcome some of them are given.

The Great Waves

Douglas Myles
New York: McGraw-Hill Book Company
1985
206 pp.

Profiles the history of tsunamis, its nature and origin from the begininng of recorded history to the present time. The book provides not only descriptions of the tsunami disasters themselves, but gives

an inside glimpse of the history of each particular era, and the interesting personal accounts of people who were affected by these events. The Foreword has been written by Dr. George Pararas-Carayannis, Director of ITIC.

Guide to IGOSS Data Archives and Exchange (Bathy and TESAC), Revised edition

Intergovernmental Oceanographic Commission/UNESCO
1985
43 pp.

This guide is intended to document the procedures to be followed in processing and archiving BATHY/TESAC data in the RNODCs for IGOSS and the World Data Centres for Oceanography. It describes the arrangements developed between IODE and IGOSS to share data so as to better serve the needs of users.

Report on the Nihonkai-Chubu Earthquake, 1983

Tokyo: Japan Meteorological Agency
1984
252 pp.

On 26 May 1983 at 1200 JST (Japan Standard Time) a large earthquake of magnitude 7.7 occurred in the Japan Sea off the western coasts of Akita and Aomori prefectures in northern Honshu. This report covers the focal parameters, seismic intensity distribution, foreshock activities, aftershock activities, focal model, analysis of records of the borehole dilatational strainmeters, observation by array seismometers at seismological observatory of JMA, geomagnetic data, seismicity in the past, tsunamis, field survey, and tsunami warnings.

[In Japanese]

A Report on the 1983 Nihonkai-Chubu Earthquake

Edited by A. Saito...et al.
Japan: Department of Ocean Civil Engineering, Tokai University
March 1984
63 pp.

A pictorial description of the Nihonka-Chubu earthquake and tsunami that struck Japan on 26 May 1983.

[In Japanese and English]

Satellite-Transmitting Sea Level Stations--1983

Bernard J. Kilonsky
Honolulu: Hawaii Institute of Geophysics
1984
40 pp.

Satellite transmitters have been installed at existing tide gauge locations in the Pacific basin so that variations of sea surface topography can be monitored in real time. The platforms have proven reliable, and the sea level information is available on a same-day basis. Tests of different sea level sensors indicate that during the first year of operation a combination of a simple shaft encoder with the satellite platform gave highly reliable and accurate measurements. The major data losses in the system were caused by errors in programming the platforms and by problems in the communication channel between the Hawaii Institute of Geophysics Planetary Geosciences Division computer and the National Oceanic and Atmospheric Administration computer in Camp Springs, Maryland.

Tsunami Climbing a Beach

E.N. Pelinovsky
Gorky: Institute of Applied Physics of the Academy of Sciences of the USSR
1985

This book is devoted to the state-of-the-art problem of tsunami climbing a beach and the estimation of tsunami action on the shore and water-development works. The hierarchy of physical and mathematical models is given for tsunami description allowing for nonlinearity, dispersion and dissipation (shallow water equations, nonlinear-dispersion theory, boundary value problems with vertical structure). Exact and approximate solutions for tsunami waves in the coastal zone are obtained within the framework of the shallow water theory. The solutions permit to calculate the fields of the level shift and the flux velocity by given tsunami characteristics in the open ocean or by run-up parameters (the latter being better known from observations). Numerical simulation of tsunami climbing a plane slope within the framework of long-wave approximations, taking into account the vertical structure of the flux is performed. Laboratory experiments on long waves climbing a plane slope are reviewed. A unitary conclusion on univalence of laws of very long wave run-up most typical of tsunamis produced by underwater earthquakes, is drawn for various models.

The methods developed are applied for the estimation of tsunami action on solid vertical obstacles. The models of contiuous waves (solitons, sinusoidal pulses) and noncontinuous waves (boras) are used for calculations. It is shown, that dispersion considerably affects the

pressure on the obstacle and slightly affects the water elevation level at the obstacle. The diffractional influence of tsunamis on vertical cylindrical obstacles is also calculated within the framework of the linear theory.

Tsunamis in Peru-Chile

Patricia A. Lockridge
Boulder, Colorado: World Data Center A for Solid Earth Geophysics
July 1985
96 pp.

This report describes the differences in seismicity and vulnerability to tsunami damage in the Peru-Chile coastal area.

PACIFIC TSUNAMI WARNING CENTER

Status of GOES Data Collection Platforms for the Tsunami Warning System

In a continuing effort to provide the Pacific Tsunami Warning Center with tsunami data on a near real-time basis, and in order to improve the Pacific Tsunami Warning System, the U. S. National Weather Service during the past year has assisted in the deployment of 16 Data Collection Platforms (DCP's) using the Geostationary Operational Environmental Satellite (GOES). These DCP's are manufactured by Handar Corporation and function as microprocessors capable of multi-channel input from a series of sensors. For tsunami purposes, sea level data from a stilling well or from a bubbler tide gauge are interfaced to the Handar DCP where the data are sampled, processed, and stored for later satellite transmission at regular self-timed intervals of 3 to 4 hours. Several emergency transmissions via GOES whenever predetermined thresholds are exceeded indicative of a tsunami being recorded at that station. Sea level data are received at PTWC within 3-4 minutes of transmission from any of the remote stations located around the Pacific.

This GOES DCP program is being accomplished through the joint efforts of the respective ITSU member nations and the U. S. National Weather Service, in close coordination with Dr. Klaus Wyrtki of the University of Hawaii and Dr. Davide Enfield of Oregon State University. Field installation costs, as well as purchase of many of the Handar DCP's, are provided through Dr. Wyrtki for island stations in the tropical Pacific, and through Dr. Enfield for stations along the west coast of South America. The sea level data transmitted by the DCP's not only provide tsunami information to PTWC on a near real-time basis, but also data for the determination of mean sea level changes for research studies being conducted by Dr. Wyrtki and Dr. Enfield as part of the

Tropical Global Atmosphere (TOGA) project. A summary of the present deployment of operational Handar DCP's follows:

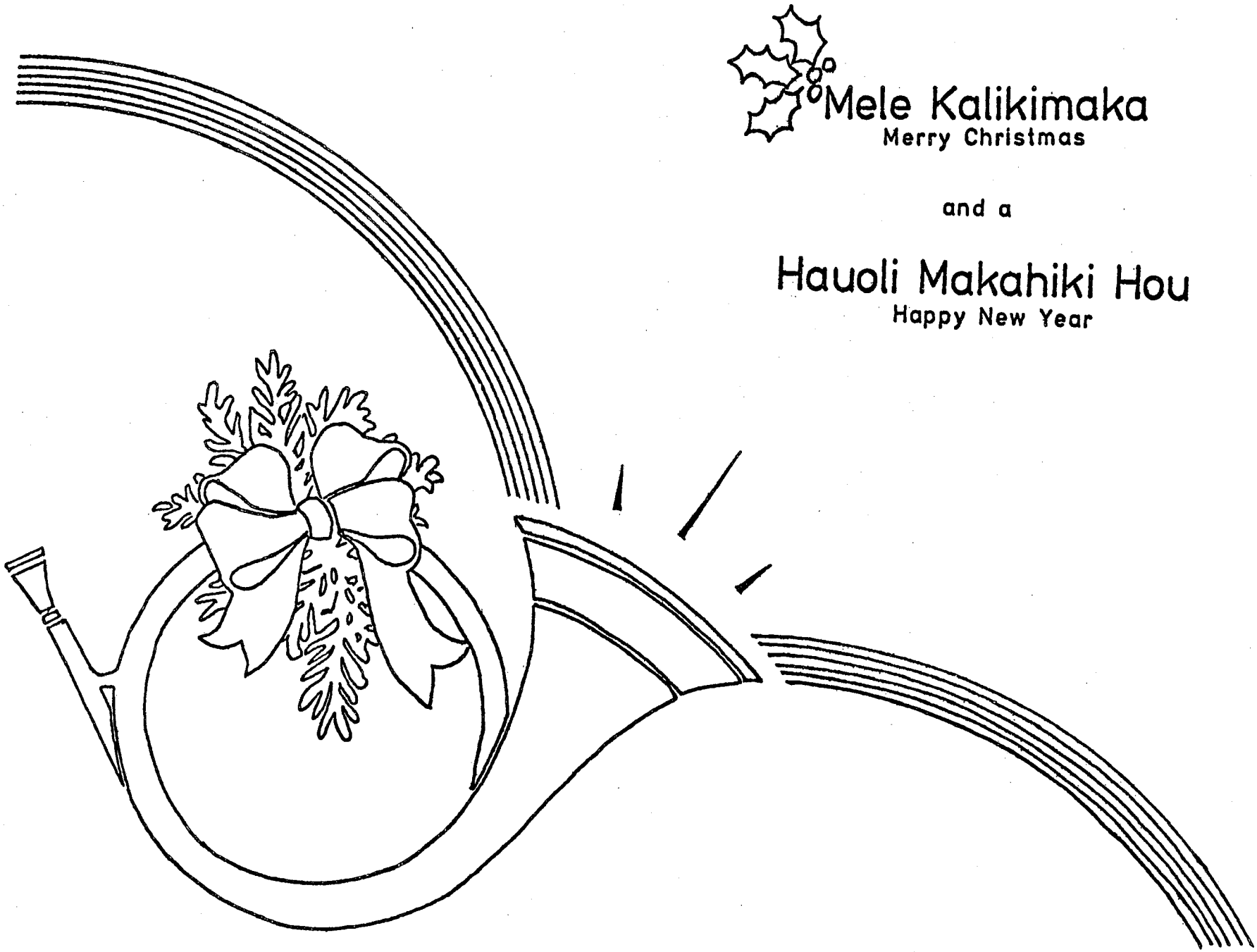
Rarotonga, Cook Islands
Honiara, Guadalcanal, Solomon Islands
Rabaul, New Britain, Papua New Guinea
Nauru
Kapingamarangi Atoll, Federated States of Micronesia
Ponape, Federated States of Micronesia
Majuro, Republic of the Marshall Islands
Tarawa, Gilbert Islands, Kiribati
Christmas Island, Kiribati
Johnston Island, U.S.A.
Baltra Island, Galapagos, Ecuador
La Libertad, Ecuador
Isla Lobos de Afuera, Peru
La Punta, Callao, Peru
Valparaiso, Chile
Arica, Chile

ITIC is presently investigating the use of such sensors which, with proper telemetry could form the basis of an inexpensive and effective Early Regional Tsunami Warning System in countries where there is potential threat of destructive tsunamis, i.e. Chile.

Roll up your trousers to the knee. Krakatoa has exploded!
(Tsunami Warning System in England in 1883?)

Seismic Summary (July 1, 1985 to Press Time)

EVENT NO.	EVENT	LOCATION	ACTION TAKEN
1985-10	Jul 3 0437Z 7.1	New Ireland, Papua, NG 04.2S 152.8E	Earthquake Information Bulletin issued
1985-11	Jul 22 0927Z 6.9	Bismark Sea 05.0S 149.1E	Earthquake Information Bulletin issued
1985-12	Jul 29 0755Z 7.0	Kabul, Afghanistan 38.8N 072.6E	No Earthquake Bulletin issued
1985-13	Aug 23 1242Z 7.2	Tashkent, USSR 40.5N 75.6E	No Earthquake Bulletin issued
1985-14	Sep 19 1318Z 7.8	West Coast of Mexico 17.8N 102.3W	Issued Regional Tsunami Watch, Watch Supplement, Watch Final Supplement
1985-15	Sep 21 0137Z 7.3	West Coast of Mexico 18.4N 101.5W	Issued Earthquake Information Bulletin
1985-16	Sep 26 0728Z 6.5	Tonga-Kermadec Trench 34.5S 178.9W	Issued Earthquake Information Bulletin
1985-17	Oct 9 0934Z 6.5	Shumagin Islands, Alaska 55.1N 159.6W	No Earthquake Information Bulletin issued
1985-18	Oct 29 1411Z 6.9	Eastern New Guinea 10.7S 148.1E	Issued Earthquake Information Bulletin
1985-19	Nov 17 0941Z 6.6	Western New Guinea 01.8S 134.1E	Issued Earthquake Information Bulletin
1985-20	Nov 28 0226Z 6.7	Vanuatu 13.4S 166.3E	Issued Earthquake Information Bulletin
1985-21	Nov 28 1500Z 7.0	Vanuatu 13.5S 166.5E	Issued Earthquake Information Bulletin



Mele Kalikimaka
Merry Christmas

and a

Hauoli Makahiki Hou
Happy New Year